REGIONAL PATTERNS OF USE AND CONSUMPTION OF ICT`S:
TOWARDS AN INFORMATION SOCIETY REGIONAL INDEX

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REGIONAL PATTERNS OF USE AND CONSUMPTION OF ICT`S: TOWARDS AN INFORMATI ON SOCIETY REGIONAL INDEX [*] [♣]

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ABSTRACT

The purpose of this paper is to describe and explain regional patterns revealed by empirical data on Spanish regions from households, firms and local governments in the 2001-2002 period. A comprehensive picture of current situation is drafted by a benchmarking exercise across Spanish regions using a compound index derived from an analytical multivariate statistical method.

Keywords: Information society, patterns, Spain, regions.

RESUMEN

El objeto de este documento es describir y explicar los patrones regionales revelados mediante datos empíricos de los hogares, empresas y gobiernos locales de las regiones españolas en el período 2001-2002. Se presenta una extensa descripción de la situación actual de las Comunidades Autónomas mediante un ejercicio de *benchmarking* para el cual se utiliza un índice compuesto derivado de un método de análisis estadístico multivariante.

Descriptores: Sociedad de la Información, patrones, España, regiones.

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[♣] Comments and suggestions by Prof. Mikel Buesa have added fruitful insights but the contents are under the sole responsibility of author.

1. INTRODUCTION.

1.1 Facts

Last thirty years from the twentieth-century an important structural change has appeared among advanced economies, the increasing importance of the service sector hand-on-hand with the availability of products and services based on the capacity of storage, sharing and transmission of large amounts of information by electronic means. Potential and actual uses are spreading out not only in the economic activities spectra but also on day-to-day life.

This phenomenon has economic as well social and cultural effects. Advanced countries, lead by the United States, have experienced an important surmount of their output and, thereof, an upward tendency on their productivity in the last nineties. In spite of lack of prompt and accurate information, assumptions about prices changes biased by improvements on vintage technologies and restrains from consumer capabilities, uncertainty on technological advances frontiers or a threshold of technology modularity and economic cycles features, some analysts and scholars have arrived to an acceptable conclusion: increase in labour productivity and growth on total factor productivity are driven by information and communication technologies (ICT's) (Schreyer, 1998, Council on Economics Advisors, 2000, Inzerillo, 2000, Jorgenson and Stiroh, 2000, Wehlan, 2000, Núñez, 2001). This argument also has their disclaimers (Solow, 1987, David, 1990, Oliner y Sichel, 1994) but it has been the starting point to provoke political concerns to reap from the expected benefits produced by the societal diffusion of these technologies.

Vast opportunities have been created by the pervasive uses of information and communication technologies. Logistics systems have improved in terms of storage, transportation and delivery. Large opportunities to long life learning have arisen through distance education. Comfort and security gains have spread out from household equipment, building and architectural electronic control devices. Clothes design has been improving and, presently, its attributes performance and connection interfaces with control and communication devices are been searched.

There by, three mechanisms must impact on the wide economy if productivity is really affected by the evolution of ICT sector:

1) We got monetary externalities if inputs' prices decrease. So, if a specific sector uses ICT products or services must appropriate benefits for gains in productivity and expenditures in developing and introducing innovations on markets by the ICT sector itself.
2) If capital accumulation affects labour productivity, massive flows of ICT investment would increase capital stock so capital-labour ratio must be affected and here in the intensity of ICT investment must influence positively labour productivity in user sectors.
3) A generalised diffusion and variegated uses of ICT's pay-off investments as technology architecture allows increases in modularity, performance, reliability, scale and scope of applications. So investment profits must improve as other many users acquire ICT's products and services.

Though these are attainable expectations, its accomplishment cannot be measured with current theoretical and analytical devices. Not even other exciting promises related to improving business, social and cultural issues as the decreasing of transaction and distribution costs, the broadening of markets, the intensification of competition, the creation of job opportunities, the enhancement of health and security remote assistance, the empowerment of people social participation, the upgrading of governance and social accountability or the achievement of a more equitable development (World Bank, 2001) are easily measured nor imputed to the growth and performance of ICT sector.

In this context, even if the empirical evidence is not robust, it may be worth to ask how to keep pace with such changes as to identify and foster opportunities to succeed in reaping economic, social and cultural expected benefits at short and long terms. So to economic development it seems like the ICT adoption is a crucial factor to succeed in world markets and in welfare gains.

1.2 Purpose

The spirit of this article is to contribute to the search of a satisfactory picture of ICT diffusion, its extent (penetration amongst societies) and the role and nature of pervasive applications in economy, society and government.

Literature on Information Society is in fluid state, concepts and statistical analysis are not systematic[1]; data is scarce, incomplete, unreliable and often not comparable[2]. Regionalisation of data is frequently not been considered in the analyses, the information is public restricted or not available.

We consider that studying ICT diffusion process and its implications for economic growth and welfare is such a complex phenomena that there is a lot of scope for a variety of approaches so we will attempt to bring some order and shed light on some aspects actually relevant for practically target regional and businesses policies taking care on similarities and differences amongst regions.

1.3 The data base

Data has been collected by INE (Spanish Statistical Office) reporting characteristics of households and industries using ICT's in 2002. Other source of information is the 2002 Survey on Internet Users by AIMC (Research Media Association). Regional

[1] A recent attempt to build a theoretical framework has been tried by Orbicom researchers based on Consumer Behavior Economics Theory. The Info-state is a welfare stage made up with Info-density and Info-use. The fist one is related to the production capacity and factor endowment of ICT capital and skills. The second one refers to the consumptive capacity quantified by the flows of ICT goods and services consumed in a period term (Sciadas, 2003). This article is devoted to this latter issue.

[2] Since 1994, OCDE, EU and UNESCO have established several think-tanks groups to tackle this problem. National statistical offices are currently participating in the deployment of a harmonized framework and testing it on the work field. Private institutions are eager to quantified Internet market size and to depict profile users to identify niches. So interest groups are pushing the generation, development and exploitation of statistical data on ICT, but this race often is rendering noisy and not reliable information.

governments` expenditures on ICT's in 2001 are taken from IRIA Report (Public Administration Ministry). Some salient features of these sources are the following:

a) The main objectives pursued by the "Information Technology in Household Survey" were to have a comprehensive picture of the ICT equipment available at homes as Internet usage of inhabitants. The survey was held in the 52 provinces of Spain and the North African autonomous cities of Ceuta and Melilla. Sample framework was based on the Active Population Survey so it only included inhabitants over fifteen years old. A two-stage stratified sample technique was used: the first stage was based on censual sections and the second on main family residences. For each region (Autonomous Community) an independent sample was designed. Final sample size established was 20,001 households (and 51,486 of their members age over fifteen years old). Two kinds of questionnaires were implemented. The first one was oriented toward household basic information and fixed telephony usage. The second was, on individual basis, addressed to Internet users on last three months reference period.

b) The purpose of the "Use of ICT and e-commerce in Companies Survey" was to analyse its usage among firms, availability of different ICT's services, its accessibility to personnel and the purchases and sales carried out by telematic networks. Its contents and design followed harmonised criteria for the fifteen EU member states. Population considered were companies with 10 or more employees whose main activity were manufacturing, production and distribution of energy, gas and water; construction, trade, catering and tourism, transport and communications, financial intermediation, rental activities and business services, and radio, television and film industries. The sample framework is the Central Companies Directory, an organised information register used in current INE statistical operations updated annually with data supplied by Tax and Social Security Administrations. The sample technique considered two criteria of stratification: by size range and economic activity. It can be mentioned that strata with 5,000 employees or over had been analysed exhaustively. Thus, sample size obtained was 13,000 firms.

c) The Survey on Internet Users is provided in the General Study on Media. Each four months three samples of equal size and design are analysed. For the annual report they're pooled together. Sample design is probabilistic on inhabitants' age fourteen years old or over. On a personal interview basis, they collect data on Internet users habits within one-month reference period. Total annual sample size is 43,000 people.

d) The IRIA Report (a Spanish acronym for Public Administrations Computer Resources) presents a picture of current situation and use of ICT in the whole set of government entities and bodies in order to orient public acquisition and purchase of ICT's products and services. Bi-annually, local and regional governments are requested to update their data. At regional level, the following institutions are considered: ministries, autonomous bodies and offices of the government delegate to an autonomous community. There are excluded public bodies, scholar centres and health establishments. Public expenditures on ICT's includes software (investment on software systems and appliances), hardware

(investments on hardware systems, local area networks and equipment rental), communications (expenditures on data transmission and telematic services), services (hardware and software maintenance, software development, training, technical and management consulting, data set-up and transcription, computing services), wages (gross salaries of personnel dedicated to ICT activities) and other expenses (consumables and various expenses).

We assume data on consumption and use of ICT's reflects deeper processes related to information society building and potentials, and, although it has some distinctive features (at regional and national level) reflects general patterns in industrial economies that behave like adopters of ICT's rather than producers. It will be also considered that expenditures on ICT's services and products reflects varied users´ needs so price is of capital importance when standard performance is expected otherwise reliability concerns will be given a higher premium.

1.4 Approach and Structure

Theoretical and empirical literature on Information Society has focused on penetration rates, which has been seen as a proxy to the current and potential social capabilities to handle, master and generate ICT. It assumes a common framework of analysis, but, actually, this is in the stage of building. So, it has left out regional factors that may affect social absorptive capacity, externalities diffusion patterns or localisation decisions (of facilities and infrastructure to produce and diffuse ICT's). It neither takes care of different paths of learning by a variety of users with different habits and expectation of consumption.

The measurement of consumers' capabilities to exploit and use, efficiently, ICT's had been pursued by several agents ranging from multilateral organisation (e.g. PNUD, UNESCO, World Bank, Eurostat), research centres (Harvard University, University of Sussex), ICT industries (e.g. Computer Systems Policy Project supported by Dell, Motorola, NCR, HP, Unisys, Intel, IBM and EMC[2]) or regulator bodies (e.g. International Telecommunications Union). Using benchmarking techniques, they have highlighted various issues affecting not only actual, but potential, use. Working with several variables they have arrived to group them in categories, give them a weight, and build an overall compound index that summarize the measurement of "readiness" of a given community (neighbourhood, professionals, citizens, stakeholders) to reach a developed stage on the Information Society[3].

This tendency had been followed in Spain. Since a few years ago, main stakeholders on telecommunication and IT's industries (Telefónica, Fundación AUNA, Telecommunication Market Commission, SEDISI –ICT industries' association-, Commerce Chambers' Confederation and N-Economía academic research group) prepare yearly reports on the advancement of information society with an extensive use of public and private (national and international) sources of information. These reports also exploit own sources based on surveys, expert panels and direct information from

[3] An extensive survey of the state of art on concepts and methodology used in the building of Information Society and Knowledge Society Indicators is presented in Bianco, et.al. (2003).

suppliers, producers and costumers. Though, whole set of information is not available on a regional basis, ICT diffusion is clearly shown to be uneven among regions, urban and rural areas and urban conglomerates[4].

In this article it will be emphasized the region as an active recipient of externalities derived from the adoption of ICT's from exogenous sources and the users´ role as contributors to knowledge stock accumulation on a collective learning pattern revealed by integrated preferences of varied costumers (households, firms and governments).

To tackle such a task, next section exploit unobserved characteristics of the use and consumption revealed by the correlation among measured variables. This is achieved by a factor analysis based on principal components. Statistically is demonstrated that regions can be described on four vectors related to households, industries, e-commerce and employment and governments' acquisitions. Deviation from an average behaviour on these dimensions revealed five clusters of regions with clearly different attributes. Section three presents a benchmarking exercise to quantify the gaps among leaders and laggards in the Spanish regions. With the empirical framework already developed, weights criteria are defined in order to assess the relative importance of the various measures and categories among regions. Finally, conclusions are presented. It seems that main regional inputs to develop information society are households and Internet usage though industry and government consumption cannot be understated.

2. REGIONAL PATTERNS.

2.1 Data analysis

The question of departure is there a convergence among society, government and industry in terms of inputs used, product and services demanded and investment required in ICT's.

So regional patterns will be obtained by factor analysis multivariate technique due to the large set of variables implicated and the impossibility to manage them without losing worth information. The factor analysis procedure will be presented in next section. After factors are obtained, Spanish regions will be grouped through a cluster analysis in order to reveal their similarities among the new factors extracted[5].

Variables obtained from public and private sources provide information about the availability of telephony, electronics and computer devices in households and industries, personal and business´ uses of communication and information technologies (i.e. Computer and telecommunication services and appliances), computer endowment, Internet connection types, electronic commercial transactions, population use habits (frequency and place to access, services used), public investment in computer services, software acquisitions, hardware expenditures and government computer equipment.

[4] A thoroughly revision on Spanish statistical sources and a critical assessment on regional benchmarking methodologies and results has been accomplished by Estrada (2003).

[5] Similar methodology has been proved successfully to shed light on similarities and differences of Spanish Regional Systems of Innovation (see Martínez-Pellitero, 2002; Martínez-Pellitero and Baumert, 2003).

2.2 Determinants of patterns

Factor analysis is a multivariate-based analytical device that permits to summarize lots of information spread out into a considerable amount of variables. In our case, we are departing from 43 variables about uses and consumption of ICT's among Spanish inhabitants, industries and governments. We consider that information society is a development stage where a community learns and deploys several, varied and interrelated civilian, private and public uses of ICT's products and services. Such a complex phenomenon can be represented by related groups of observable variables. From their correlations arrives under lying dimensions that simplifies our understanding of key or driving forces that guide transition from post-industrial society to the new information era.

High effectiveness has been obtained by this method. Out of the 43 original variables have been extracted four factors explaining 92% of total variance. Factors have been extracted using Principal Component Analysis. To gain clarity a rotated factor matrix was produced so the number of variables highly correlated with each factor will be minimized.

Table 1. Factorial analysis efficiency: Total Variance Explained.

Factor	Eigenvalue	% Of variance Explained	Cumulative %
1	36,8	59,3	59,3
2	10,5	16,9	76,3
3	7,5	12,1	88,3
4	2,4	3,9	92,2

The first factor relates to household environment. It reflects habits of consumption among users and households, home based technological launch pads to connect to the Internet and potential devices for scaling modularity (consumer electronics and telecom equipment). Also it includes government demand in computer equipment and services as awareness of security issues in business represented by electronic data interchange sales.

The second factor relates, mainly, to the importance of penetration of ICT's in firms and its access to employees. Price sensitiveness in homes (proxied by average expenditures in fixed telephony) is also grouped in this factor.

The third factor summarizes ICT employment, e-commerce and external modes of remote communication and coordination activities in industries.

The last factor represents governmental efforts to keep pace with modernisation reflected by public expenditures in ICT acquisitions per population and software public demand.

Table 2. Factorial analysis results: Component rotated matrix.

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	
	HOUSEHOLD ENVIRONMENT	*INDUSTRIAL ICT PENETRATION*	*EMPLOYMENT AND E-COMMERCE*	*GOVERNMENT' S EFFORTS*	**COMMUNALITY**
FIXED TELEPHONY EQUIPMENT					
Households with fixed telephone	0,98	0,07	0,18	0,05	0.99
Phones	0,96	0,13	0,24	0,01	0.99
Telephone lines in principal home	0,97	0,09	0,19	0,04	0.99
Telephone lines in second home	0,82	0,30	0,43	-0,09	0.95
Fixed telephone companies contracted	0,98	0,09	0,18	0,05	0.99
CONSUMERS ELECTRONICS AND COMPUTERS					
Television	0,99	0,03	0,13	0,06	0.99
Personal Computer	0,93	0,20	0,30	0,00	0.99
Fax	0,92	0,26	0,27	-0,01	0.98
Video	0,98	0,09	0,15	0,04	0.99
DVD	0,95	0,17	0,23	0,02	0.98
Sound system	0,96	0,12	0,24	0,05	0.99
Radio cassette	0,98	0,07	0,18	0,06	0.99
Bleeper	0,91	0,04	0,10	-0,01	0.83
Mobile	0,97	0,08	0,19	0,06	0.99
INTERNET ACCESS AND CONNECTIVITY					
Households with Internet access	0,89	0,29	0,33	-0,05	0.98
RDSL connection	0,79	0,28	0,42	-0,08	0.89
ADSL connection	0,75	0,23	0,51	-0,09	0.89
INTERNET PERSONAL USES					
One month latest use	0,96	0,17	0,20	0,05	0.99
Yesterday latest use	0,94	0,23	0,22	-0,01	0.99
2 to 7 days latest	0,96	0,15	0,20	0,06	0.99
8 days to 1 month latest use	0,94	0,00	0,13	0,21	0.95
Over one month latest use	0,92	-0,03	-0,05	0,25	0.91
Home (latest access)	0,93	0,25	0,24	0,01	0.99
Work (latest access)	0,90	0,27	0,34	0,00	0.98
University/school (latest access)	0,97	0,15	0,04	0,09	0.97
Other site (latest access)	0,93	-0,06	-0,05	0,23	0.92
Internet users (last 3 months)	0,90	0,23	0,38	0,00	0.99

Place of use: Home	0,88	0,30	0,36	-0,06	0.99
Place of use: Workplace	0,81	0,28	0,50	-0,07	0.98
Place of use: School	0,94	0,13	0,28	0,08	0.99
Place of use: others´ home	0,91	0,11	0,32	0,16	0.96
Place of use: other places	0,92	0,05	0,33	0,05	0.95
On-line purchasers (last 3 months)	0,78	0,29	0,52	-0,09	0.98
INTERNET SERVICES					
Web (personal access)	0,96	0,16	0,20	0,06	0.99
e-mail (personal access)	0,94	0,21	0,27	0,02	0.99
FTP (personal access)	0,90	0,19	0,36	-0,02	0.98
Chats/IRC (personal access)	0,97	0,02	0,02	0,11	0.96
News-groups (personal access)	0,91	0,09	0,33	0,09	0.94
Other uses (personal access)	0,94	0,07	0,10	0,14	0.92
GOVERNMENT SUPPORT INFRASTRUCTURE					
Computer services government's expenditures	0,79	0,28	-0,14	0,39	0.88
Government computer equipment	0,70	0,03	0,06	0,66	0.93
NETWORK APPLIANCES					
EDI sales	0,74	0,43	0,10	-0,23	0.79
ICT´S INDUSTRIAL AVAILABILITY AND PENETRATION					
Internet (% of firms)	-0,09	0,92	-0,15	-0,11	0.89
Intranet (% of firms)	0,27	0,88	0,20	0,01	0.87
e-mail (% of firms)	-0,11	0,92	-0,08	-0,10	0.87
Bleeper service (% of firms)	-0,04	0,80	0,17	0,39	0.83
Switchboard (% of firms)	0,06	0,77	0,33	-0,04	0.70
LAN (% of firms)	0,35	0,78	0,33	-0,07	0.83
Data transmission circuit (% of firms)	-0,04	0,77	0,47	-0,09	0.82
Web site (% of firms)	0,29	0,61	0,36	-0,24	0.63
Internet access (% of employees)	0,30	0,80	0,33	0,10	0.85
e-mail access (% of employees)	0,27	0,78	0,45	0,21	0.92
PC access (% of employees)	0,21	0,77	0,48	0,19	0.89
Intranet access (% of employees)	0,28	0,66	0,63	0,14	0.93
HOUSEHOLDS EXPENDITURES IN FIXED TELEPHONY					
Total calls (average expenditures €/month)	0,22	0,66	-0,01	0,26	0.54

ICT EMPLOYMENT AND E-COMMERCE					
% of employees in ICT	0,22	0,40	0,81	0,11	0.88
Internet sales	0,52	0,36	0,72	-0,14	0.95
Internet purchases	0,46	0,35	0,77	-0,19	0.93
Extranet access (% of employees)	0,42	0,43	0,70	-0,01	0.84
Extranet access (% of firms)	0,37	0,32	0,60	0,17	0.62
GOVERNMENT EXPENDITURES IN ICT					
Software government expenditures	0,60	0,04	0,29	0,70	0.94
Computer government expenditures (€/people)	-0,08	0,55	-0,29	0,68	0.86

2.3 Differences among regions

With the four factors revealed in the latter analysis we will be able to identify homogenous groups of regions, that is patterns of use and consumption on ICT's based on a variety of summarized variables. We'll use a cluster analysis to search for similarities and differences among Spanish regions[6].

In our analysis we will combine two different cluster analysis, the first one, a hierarchical method, will provide information about the optimal number of groups and to establish the centroids, the second, non hierarchical, will bring out the optimal solution with that number of groups.

The clustering schedule shows that when arriving to a five-solution group there is a large jump in the distance coefficients advising to stop the group formation to preserve a suitable homogeneity within the groups. The centroids are derived from the means of the four factors in the five groups obtained. The optimal solution calculated with the non-hierarchical method is identical to the initial centroids obtained with the hierarchical clustering. An analysis of variance proves that there are significant differences among the groups of cases proposed.

[6] A matrix of distances is calculated considering the squared Euclidean distance between all pairs of cases. For combining clusters will use the Ward method: for each cluster the means for all variables is calculated, then these distances are summed for all the cases. In the next steps, the clusters merged are those that result in the smallest increase in overall sum of the squared distance.

Table 3. Regional patterns of use and consumption of ICT´s.

	Sophisticated household regions	***Conservative household regions***	***Conservative industry regions***	***Sophisticated labour and trade regions***	***Sophisticated government regions***	
	Cluster 1	*Cluster 2*	*Cluster 3*	*Cluster 4*	*Cluster 5*	Total
FACTOR 1 ***Household Penetration***	1,85	-0,71	-0,12	1,04	-0,31	0,00
FACTOR 2 ***Industrial Penetration***	0,15	0,36	-1,12	0,87	1,40	0,00
FACTOR 3 ***Employment and e-Commerce***	-0,86	-0,19	0,14	3,29	0,17	0,00
FACTOR 4 ***Public Expenditures***	-0,24	-0,42	0,25	-0,25	3,03	0,00

The interpretation of clusters is based on the means values on the factors already explained in the past section.

Cluster 1 (Sophisticated household regions): It has been form by regions with an outstanding performance in household devices availability, personal uses of Internet, public demand on computer equipment and services and a bigger awareness of network security (Factor 1). Also it reflects low industrial Internet e-commerce, little access and use of extranet as well as few job opportunities in ICT employment (Factor 3). In industrial ICT penetration (Factor 2) they are marginally above average. They behave below average in government software acquisition and computer expenditures per inhabitant. Here we found Andalusia, Catalonia and Valencia.

Cluster 2 (Conservative household regions): Regions with household ICT equipment shortage, scarce and hardship Internet access and connectivity (Factor 1) and a lack of interest on public investments on computers (Factor4). Local industry is penetrated above average by ICT's (Factor 2) but employment generation and electronic transactions are still low (Factor 3). This group is composed of Aragon, Asturias, the Balearics, Ceuta and Melilla, Cantabria, Murcia, Navarre and La Rioja.

Cluster 3 (Conservative industry regions): Poor availability and penetration of information and communication technologies in economic activities and a high sensitiveness to change in ICT prices reflected on low consumption on household fixed telephony are the salient features in this group (Factor 2). Home availability and personal Internet uses are, lightly, below average (Factor 1) while e-commerce and job opportunities record, marginally, above that threshold (Factor 3). Government expenditures in IT per capita perform a little bit better but still lagged behind the leaders (Factor 4). The regions that belong to this cluster are Castile and León, Castile-La Mancha, Extremadura, Galicia and the Canaries.

Cluster 4 (Sophisticated labour and trade regions): Regions are characterized by high offering on ICT jobs, a strong use of Internet for commercial transactions, as well as generalized use of extranet among industries and employees (Factor 3). They follow,

closely, the leadership in household devices availability, Internet personal uses, public infrastructure and demand as well as network security awareness (Factor 1). Such follower behaviour is also reflected in ICT penetration and accessibility among industrial sectors (Factor2). But government acquires few software and computer public expenditures are low in comparison with total population (Factor 4). This group is formed by Madrid.

Cluster 5 (Sophisticated government regions): Government computer expenditures are higher in terms of population and software acquisitions (Factor 4). Furthermore, broad industrial availability of information and communication equipment and services as high expenditures in fixed telephony at homes characterise these regions(Factor 2). ICT home-based equipment availability, personal uses of Internet and trusting on web security below the average (Factor 1), meanwhile employment opportunities and e-commerce are, slightly, above average (Factor 3). Basque Country is the sole region in this cluster.

3. INDEX APPROACH.

3.1 Index composition

From the four factors revealed in the Factor Analysis we can derive a single measure of the performance of Spanish regions. This single measure is composed by the whole set of variables, its correlations and contributions to common factors. Each factor explains certain amount of variability, so this information provides us with criteria to weight its relative importance. Noteworthy, each factor corresponds to an unobservable dimension of the regional behaviour with maximum correlation inside its constituents and maximum uncorrelation among the other dimensions. Variability figures provide a quantitative measure of the attribute described. Such a measure represents a partial index.

Each partial index is composed by several variables. Their weights inside the indexes are obtained from their loadings. It is worth to notice that each variable has been exclusively assigned to an only one common factor. Each weight is calculated as the percentage of the correlation between the variable and the factor and the correlation of the factor amongst all variables.

In table 4 it is shown the constituents of the four partial indexes, its sum represents the overall index, this can be named as the Information Society Regional Index. The partial index with most important relevance is the Household Penetration Index with a weight of 64%. Here we can find Internet interfaces household devices and citizens habits of use and consumption on ICT's. The second most important factor, with a weight of 18%, is the Industry Penetration Index that describes the industry communication equipment endowments and accessibility to information technologies. The next one, in the hierarchy is the E-commerce and Employment Index weighted with a 13% of relevance. The sales and purchases on the Internet, the extranet diffusion and accessibility as well as job opportunities in the industry are portrayed in this factor.

Finally the Public Expenditures Index provides a 4% of the importance of the intensity of the expenditures of local governments and their demand on software.

Table 4. Information Society Regional Index Composition.

Partial Indexes	Variables	Relative Weights
	FIXED TELEPHONY EQUIPMENT	
Partial Index 1:	Households with fixed telephone	3%
	Phones	3%
	Telephone lines in first residence	3%
	Telephone lines in second residence	2%
HOUSEHOLD	Fixed telephone companies contracted	3%
	CONSUMERS ELECTRONICS AND COMPUTERS	
	Television	3%
	Personal Computer	2%
	Fax	2%
	Video	3%
PENETRATION	DVD	2%
	Sound system	3%
	Radio cassette	3%
	Bleeper	2%
	Mobile	3%
	INTERNET ACCESS AND CONNECTIVITY	
Weight: 64%	Households with Internet access	2%
	RDSL connection	2%
	ADSL connection	2%
	INTERNET PERSONAL USES	
	One month late use	3%
	Yesterday late use	2%
	2 to 7 days late use	3%
	8 day to one month late use	2%
	Over one month late use	2%
	Home (late access)	2%
	Work (late access)	2%
	University/school (late access)	3%
	Other site (late access)	2%
	Internet users (last 3 months)	2%
	Place of use: Home	2%
	Place of use: Workplace	2%
	Place of use: School	2%
	Place of use: others´ home	2%
	Place of use: other places	2%
	On-line purchasers (last 3 months)	2%
	INTERNET SERVICES	
	Web (personal access)	3%
	e-mail (personal access)	2%
	FTP (personal access)	2%
	Chats/IRC (personal access)	3%
	News-groups (personal access)	2%
	Other uses (personal access)	2%

	GOVERNMENT SUPPORT INFRASTRUCTURE	
	Computer services government's expenditures	2%
	Government computer equipment	2%
	NETWORK APPLIANCES	
	EDI sales	2%
Partial Index 2:	**ICT´S AVAILABILITY AND PENETRATION**	
	Internet (% of firms)	9%
INDUSTRIAL	Intranet (% of firms)	9%
	e-mail (% of firms)	9%
PENETRATION	Bleeper service (% of firms)	8%
	Switchboard (% of firms)	8%
	LAN (% of firms)	8%
Weight: 18%	Data transmission circuit (% of firms)	8%
	Web site (% of firms)	6%
	Internet access (% of employees)	8%
	e-mail access (% of employees)	8%
	PC access (% of employees)	8%
	Intranet access (% of employees)	7%
	AVERAGE EXPENDITURES IN FIXED TELEPHONY	
	Total calls (average expenditures €/month)	7%
Partial Index 3:	**ICT EMPLOYMENT AND E-COMMERCE**	
	% of employees in ICT	23%
EMPLOYMENT AND	Internet sales	20%
E-COMMERCE	Internet purchases	21%
	Extranet access (% of employees)	19%
Weight: 13%	Extranet (% of firms)	17%
Partial Index 4:	**GOVERNMENT EXPENDITURES IN ICT**	
PUBLIC EXPENDITURES	Software government ´s expenditures	51%
Weight: 4%	Computer government ´s expenditures (€/people)	49%

3.2 Benchmarking exercise

To prove index valuation, variables have been standardized giving value of one to the maximum values and zero to the minimum ones. Standardized values have been weighted by the appropriate factor derived in the previous section. Partial indexes are obtained as the sum of the standardized weighted values. The complete index is also the sum of partial indexes values weighted by their appropriate factor. All values are considered as percentages. The coefficients obtained measures relative position of each region with respect the whole set of regions. Values rank from 0 to 100.

Table 5. Regional benchmarking using Information Society Regional Index: Partial Indexes and Complete Index.

SPANISH REGIONS	Household Penetration: 64%	RANK	Industry Penetration: 18%	RANK	E-commerce And Employment: 13%	RANK	Public Expenditures: 4%	RANK	Information Society Regional Index	RANK
ANDALUSIA	79,57	3	34,51	10	19,17	7	59,52	2	**62,56**	**3**
ARAGON	12,86	10	44,27	7	29,67	4	3,22	18	**20,40**	**10**
ASTURIAS	10,40	11	37,61	8	22,71	5	20,81	10	**17,44**	**11**
BALEARICS	8,68	13	62,92	5	20,79	6	19,76	11	**20,68**	**9**
BASQUE COUNTRY	31,03	5	75,04	2	31,06	3	100,00	1	**42,05**	**4**
CANARY ISLANDS	21,36	8	32,04	11	17,83	9	29,85	8	**23,22**	**8**
CANTABRIA	4,12	16	31,66	12	12,25	12	12,05	15	**10,57**	**16**
CASTILE AND LEÓN	26,14	7	26,91	15	12,82	11	30,12	7	**24,71**	**7**
CASTILE-LA MANCHA	13,10	9	9,64	18	3,10	16	15,78	14	**11,27**	**15**
CATALONIA	91,36	1	74,38	3	46,05	2	27,75	9	**79,62**	**2**
CEUTA AND MELILLA	0,19	18	66,45	4	2,21	18	34,66	4	**14,07**	**13**
EXTREMADURA	7,80	14	10,68	17	3,08	17	12,01	16	**7,89**	**18**
GALICIA	29,22	6	14,61	16	16,57	10	34,02	5	**25,09**	**6**
LA RIOJA	1,27	17	36,81	9	7,61	15	6,29	17	**8,82**	**17**
MADRID	81,32	2	88,67	1	100,00	1	44,91	3	**83,55**	**1**
MURCIA	9,34	12	28,20	14	9,53	14	17,06	13	**13,15**	**14**
NAVARRE	4,82	15	57,45	6	19,04	8	17,74	12	**16,88**	**12**
VALENCIA	46,61	4	31,15	13	10,24	13	33,50	6	**38,47**	**5**

Catalonia leads the partial index of household penetration and Internet uses. Households in Catalonia are well fitted with telephone equipment, consumer electronics and computers as Internet accessibility. ADSL broadband facilities in homes are diffusing among users at average rates. Among the Spanish regions the Internet is most frequently use. On site of access to the web, Catalonians rank first from home, workplace or school. The Catalonians are the main consumers of the web and the e-mail. Regional government, known as Generalitat, is the main buyer of computer services. Despite this feature, Generalitat computer equipment availability is average.

The second place goes to Madrid. Fixed telephony equipment household availability is outstanding but a little lower than in Catalonia. Homes at Madrid are fitted above average and show preference for personal computers and audiovisual equipments. Bleeper systems are at average consumption. Internet access and connectivity also perform above average but ADSL broadband demand leads the country. Habits on Internet uses and consumption on services are above average. Inhabitants of Madrid are the most constant Internet users and the main purchasers on the web. Also, they are the principal source of consumption of FTPs (Files to Protocol) and news groups. Government computer equipment availability is average but its spending on computer services is low.

Andalusia shares a similar situation with Madrid in regards of household fixed telephone equipment. An exemption is the below average availability of telephone line in second residence. Andalusia is the national leader in television and mobile availability at home. Also, in another consumer electronics achieves high performance.

Internet home access is at average. Poor diffusion of broadband facilities among homes is found. Andalusians prefer to use Internet periodically and from public places. They also are the leaders in chats/IRC consumption. Regional government has high expenditures on computers services and possesses considerable computer equipment.

In respect with the Industry Penetration Partial Index, Madrid is the leader region. Its strong position is sustained by the availability of telecommunications equipment such as Local Area Networks and Closed Data Transmission Circuits. Madrid industry has pervasively corporate web sites. Also its employees are the best fitted out with personal computers, e-mail, intra and Internets. This buoyant situation contrasts with industry diffusion of ICT's because other regions industries portray a better diffusion of the Internet and e-mail among their economic activities (i.e. Ceuta and Melilla, Basque Country, Balearics and Catalonia). Price sensitiveness, proxied by private telephone consumption, lagged behind the North African autonomous cities of Ceuta and Melilla and the Canary Islands.

Basque Country is the second region rank in the Industry Penetration Partial Index. It achieves very good performance in telecomm basic structure such as switchboard and bleeper services but also a considerable amount of its workforce and industries have access to the Internet, intranet, web and the email. An average value is shown by the price sensitiveness of its citizens.

Catalonia is the third region in this industrial index. Intranet availability and website offerings are the hallmark of this region. Meanwhile, labour force has the same difficulties of access to the intranet as the rest of the country or at least, just above average to access to a personal computer. The monthly spending on residential phone calls is below average showing some price sensitiveness among Catalonians.

The indisputable leader on ICT job offering and electronic transactions is Madrid. On job offers Madrid is an outlier. Following regions, as Aragon and Basque Country, are strongly lagging behind. Same situation appears in reference to Internet sales and purchases where Catalonia is following at far. In the use and accessibility of remote coordination and communication networks (i.e. extranet) gaps are narrower, but it seems no convergence between firm and employees accessibility as Balearics and Navarre figures show.

Catalonia deserves second position in E-commerce and employment rankings. Extranet penetration among industries and the availability of this technology for its workforce score above average. Electronic transactions are almost at average. A paramount weakness stems from its low ICT employment sharing on industrial workforce.

Basque Country sustains its third place on this partial index because of its shares on ICT employment. In this figure, Basque region scores almost as high as Aragon, but they are, actually, far from the leader, performing, both of them, below the average. Roughly, extranet diffusion is at an average band, where industrial penetration is at the upper rank and labour accessibility for this information technology is at the bottom. Noteworthy, that Spanish islands, the Balearics and Canaries, achieve a good performance on extranet industrial penetration. In respect to Basque Country weaknesses, it has been observed a scarce volume of Internet electronic transactions.

Finally, the behaviour on the last factor, public expenditures, reveals that the Basque Country is the national leader. Its regional government head public efforts on computers expenditures per inhabitant and also on software acquisitions. The rest of the autonomous communities spend up to one-third of Basque Country expenditures. The exemptions are the autonomous cities of Ceuta and Melilla with expenditures of two-thirds of Basque government. Other important software buyers are Madrid and Andalusia governments, which rank third and second, respectively, on the public expenditures partial index.

As expected, if we obtain the score of the Information Society Regional Index from the sum of the weighted partial indexes, Madrid is the national leader. Its households are well fitted with ICT-s as well as its workforce has a pervasive access to these technologies, outstanding position is held by the industrial telecom equipment availability, its labour market is demanding qualified people in ICT's, its industry is the big player in the volume of e-commerce transactions and its citizens are the main purchasers by the web.

Catalonia has the role of challenger to Madrid. Its households have the best endowments of ICT's. Catalonians are the main users of the web and e-mail services, its industries use currently the intranet and extranet, its enterprises has a prominent presence in Internet reflected by its corporate websites but users reflect some price sensitiveness.

Andalusia is following the leaders. In respect with household, facilities are not so widely disperse but this is compensated by the extended availability of televisions and mobiles at homes. Government has the major computer equipment and pulls public demand for services and software.

In fourth place we've got the Basque Country. Its industry is gifted with such good basic telecom equipment and its employees have the best accessibility to ICT's. Another salient feature is the overwhelming government expenditures in computers per inhabitant.

Valencia ranks fifth position. Household penetration is roughly average. Homes are well fitted out with electronics and computer equipment. Internet accessibility, personal uses and contents demanded are below average level. Information technology diffusion in industry is as high as average but telecom equipment availability is below that threshold. Employees' accessibility to relevant technology is low. Also government expenditures show those levels. Main concern is in ICT employment and e-commerce index with very low values.

Next regions in the complete index are Galicia, Castile and León and Canaries. These communities perform roughly below average in household penetration and public expenditures indexes. With the exemption of Canaries, industrial penetration is very weak.

Places ninth through fourteenth go to Balearics, Aragon, Asturias, Navarre, Ceuta and Melilla and Murcia. Score performance on these regions reflects below average

behaviour on industrial penetration. Also employment and e-commerce index shares similar figures with the exemption of Ceuta and Melilla, which are the laggards in this issue.

Castile-La Mancha shows similar pattern with Galicia ´s block but performing worst in public expenditures. In industrial penetration holds the last position. Cantabria and La Rioja are almost in the same situation but in household and public expenditures indexes. Finally, the Extremadura region is last. Households are better positioned than the rest of elements in the index.

4. CONCLUSIONS.

A reliable statistical analysis has been done in order to compare generalized and specific patterns of societal use and consumption of ICT's (infotization or computerization, in the jargon) based on collective learning of a variety of users.

Four domains are clearly shown to harness current situation on the development of an Information Society: household, industry, labour and commerce ICT-based and public expenditures. The usage of Internet (services used, place and frequency of access) and the household consumption of electronics, audiovisual, fixed telecomm and computer equipments are the main driving force of ICT on a market pull diffusion society.

Though, industry and government cannot be understated. Structural changes are expected to arrive since ICT demands of products and services increases in scale and scope. Within these changes services and labour market will suffer most dramatically ones. Meanwhile, a digital divide is emerging among regions with industrial and financial capacity to reassign resources in order to cope with these changes. At firm-level organizations are suffering from cultural anchorage and inertia that impedes to empower employees with Information Technologies and diffuse physical boundaries within departments, units, subsidiaries, partners, contractors, clients and even the market-place.

Although public expenditures are increasing object of social accountability and fiscal restrains, they still play a role as multiplier of the demand of new technology in particular in the ICT products and services. Timesaving electronic procedures are available from computer modernization as a trademark of an efficient administration. Government infrastructure can be the launch pad for demonstrative purposes for the ICT contents and services industries, as well as the natural learning inducement channel for the majority of citizens.

Considering these four areas, Spanish case revealed five patterns. Three groups of regions perform above average and are leading the country in at least one dimension (Madrid, on ICT employment and e-commerce as well as on industrial penetration; Basque Country, in public expenditures; and the triad cluster composed by Catalonia, Andalusia and Valencia, in the household index). Another group, as crowded as the former (both Castiles, La Mancha and León; Extremadura, Galicia and the Canaries), may be the reference to the country because of its average scoring despite its bad performance in the industrial penetration index. This feature may be due to industrial structural circumstances with a bias towards natural resources and tourism activities.

Finally, it appears the laggard group with the littlest scores (Aragon, Asturias, Balearics, Ceuta and Melilla, Cantabria, Murcia, Navarre and La Rioja). Its underdeveloped position may be explained by its weak performance in household penetration and Internet usage. Noteworthy, industrial penetration in this group is average so it may be consider the country ´s reference instead of the latter group.

An index has been built in order to quantify differences on ICT ´s uses and consumption among regions. Gaps are clearly shown even among similar regions according with the patterns already described. In Spanish regions, household presents the widest gap and the narrower is in industrial penetration. A critical gap also appears between leaders and the rest of the country in e-commerce and employment as well as on public expenditures.

To improve current situation and to decrease gaps among Spanish regions it is recommended to empower social participation in the net and household accessibility, to create job opportunities based on ICT's and to enhance employees' accessibility to ICT's on workplace.

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